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Comparison of Native Grasses and Crested Wheatgrass and of Supplements for Beef Cattle in the Northern Great Plains¹

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INTRODUCTION

The native vegetation of the northern Great Plains consists of a rather large number of species from different families. In the locality of the Ardmore Field Station, Ardmore, S. Dak., where these experiments were conducted, the dominating grasses are western wheatgrass (*Agropyron smithii* Rydb.), buffalo grass (*Buchloë dactyloides* (Nutt.) Engelm.), and blue grama (*Bouteloua gracilis* (H. B. K.) Lag.).

Western wheatgrass is the most widely distributed species and probably furnishes more hay and grazing than any other grass in the area. Numerous experiments at this station and others have demonstrated its feeding and grazing qualities. Experiments during a 5-year period (1923-28) showed (4)³ that a ration of 15 pounds of wheatgrass hay was as satisfactory as a similar quantity of alfalfa hay for wintering yearling steers. Although the alfalfa-fed steers made slightly greater winter gains, the wheatgrass-fed steers made somewhat greater subsequent summer gains on native range and about 15 pounds more total winter and summer gains. The average results of three experiments (1927-30) showed (1) that about 12 percent more alfalfa than western wheatgrass hay was required for the same gain on yearling heifers wintered in dry lot. The alfalfa hay, however, was

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² Transferred to Soil Conservation Service of the Department on July 13, 1942.

³ Italic numbers in parentheses refer to Literature Cited, p. 11.

slightly inferior to the wheatgrass hay in 2 of the years. No material differences resulted in the following summer gains of the heifers grazing native range. In studies carried on at the United States Range Livestock Experiment Station, Miles City, Mont. (6) in 1929-34, breeding cows were wintered on native range, largely western wheatgrass, without supplemental feed for 3 of the 5 years. During very brief periods when the range was snow-covered, these cows were able to subsist on such browse species as sagebrush, yucca, and greasewood.

Experiments at the Ardmore station from 1928 to 1933 (5) showed that it was much more economical to winter steers on native range and to feed concentrates or dry roughage in extremely bad weather or when the vegetation was snow-covered than to winter them in the feed lot on such feeds as alfalfa hay and oat straw, corn silage and oat straw, or sorgo fodder. Later work at this station (1933-36) also showed (3) that steers could be wintered on the range satisfactorily with comparatively small quantities of grain and roughage and more economically than in the feed lot on a moderate ration of native roughage and cottonseed meal. Summer gains of steers grazing native range were materially increased by feeding a grain supplement. Under the conditions of the experiments, the extra cost of the supplement was more than offset by the increased sales value of the steers due to their high condition.

In experiments at Ardmore from 1919 to 1933, more than 7 acres of native range per steer 1 year or more old (2) was required during the summer grazing season. Overgrazing of vegetation of the type used in the pastures resulted in severe losses in weight of the steers toward the end of the grazing season. Alternate grazing was more satisfactory than continuous grazing when rate of stocking was the same. Four years of experiments at the same station from 1936 to 1940 showed that approximately 20 acres of native range per steer was sufficient to carry the animals from yearlings to 2-year-olds under yearlong grazing. There was no advantage in alternate grazing over continuous grazing as measured by the steer gains. After 4 years of yearlong grazing there was no indication that the pastures had been overgrazed.

Observations of small areas planted to crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.) at the Ardmore station about 10 years ago and grazed by beef cattle have given rise to the belief that this grass has good possibilities as a grazing forage for cattle in the northern Great Plains. Interest has been manifested in it rather generally throughout this area. Crested wheatgrass is a hardy drought-resistant perennial bunchgrass native to the cold dry plains of Russia and Siberia (8). Although it was introduced into the United States in 1898, the possibilities of the grass attracted little attention until after 1915, when it was planted in the northern Great Plains. Its adaptability to this area is shown in figure 1.

In experiments conducted at the Judith Basin Branch Station at Moccasin, Mont., from 1934 to 1940, crested wheatgrass pastures during a 7-year period produced greater total gains per steer and per acre than either native grass or brome grass pasture (9). The crested wheatgrass furnished grazing 2 to 3 weeks earlier in the spring, but in average daily gains per animal there was little difference in the three pastures.

The experiments reported in this circular were designed to compare the feeding values of crested wheatgrass and of native grasses (predominantly western wheatgrass) as hays and as range for grazing. The facilities at the Ardmore station also provided an opportunity to study the relative values of cottonseed cake and of beet pulp-molasses pellets as supplements to native range for wintering cattle. The work was conducted during two winter periods and one summer grazing season and extended from December 12, 1940, to May 1, 1942.

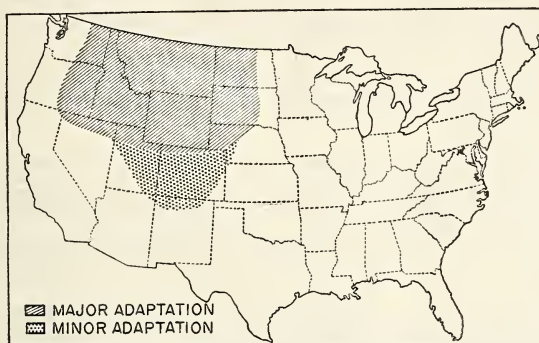


FIGURE 1.—Adaptation of crested wheatgrass to the northern Great Plains.

WEATHER CONDITIONS DURING THE EXPERIMENTS

The temperatures and precipitation at the Ardmore station during the experiments are shown in table 1. The monthly range and the

TABLE 1.—*Monthly temperatures and precipitation during the experiments and for 1912-40, at the Ardmore Field Station, Ardmore, S. Dak.*

Month	1940-41				1941-42				1912-40	
	Temperature			Pre- cipi- tation	Temperature			Pre- cipi- tation	Mean tem- pera- ture	Pre- cipi- tation
	Maxi- mum	Mini- mum	Mean		Maxi- mum	Mini- mum	Mean			
	° F.	° F.	° F.	Inches	° F.	° F.	° F.	Inches	° F.	Inches
December.....	67	-24	23	0.24	77	-21	25	0.94	22	0.33
January.....	60	-9	22	.30	48	-28	17	.04	20	.35
February.....	57	5	28	.19	54	-15	21	.76	23	.38
March.....	72	1	32	.84	65	14	33	1.17	33	.82
April.....	74	22	46	4.44	86	23	47	6.08	44	2.01
May.....	94	33	61	.69					55	2.78
June.....	94	38	61	5.42					65	2.52
July.....	100	52	73	4.07					73	1.99
August.....	104	44	73	1.41					71	1.62
September.....	95	21	58	1.08					61	1.08
October.....	84	15	46	.81					47	1.14
November.....	69	-18	37	.45					34	.45

means in temperature were normal, as there was little variation from the average for the 28-year period 1912-40. The precipitation from December through March was likewise similar to the average for the 1912-40 period. In April, June, and July of 1941, however, it was considerably heavier than for the preceding 28-year average. Snow-

fall was unusually light during the winter of 1940-41, and at no time was it necessary to feed roughage to the cattle wintered on the range during that year's test. During the winter of 1941-42, it was necessary to feed hay from December 23 to January 11 to the groups wintered on the range.

EXPERIMENTAL PROCEDURE

For use in the experiments 40 head of well-bred Hereford cattle, consisting of 28 steers and 12 spayed heifers approximately 1½ years of age, were brought to the Ardmore station from the United States Range Livestock Experiment Station at Miles City, Mont. These cattle were allotted into 4 groups of 7 steers and 3 heifers each and handled as follows:

- Group 1. Wintered in dry lot on native hay (77-percent western wheatgrass); summer-grazed on native range.
- Group 2. Wintered in dry lot on crested wheatgrass hay; summer-grazed on crested wheatgrass pasture.
- Group 3. Wintered on native range with a supplement of cottonseed cake (43-percent protein) and a small quantity of bonemeal; summer-grazed on native range.
- Group 4. Wintered on native range with a supplement of pellets composed of approximately 82 percent of beet pulp, 15 percent of molasses, and 3 percent of bonemeal; summer-grazed on native range.

The same cattle were used throughout these experiments. During the wintering period of 140 days the groups in dry lot were fed approximately the same quantities of hay, but less was fed the second winter than the first because the gains of the cattle in the first test were somewhat greater than necessary. The two groups wintered on native range had the use of approximately 470 acres and were fed about 1 pound of concentrate supplement per head daily. The same quantity of bonemeal was fed to both of these groups in order that a comparison of a strictly carbohydrate concentrate with a protein concentrate might be made.

During the summer, crested wheatgrass pasture was stocked at the rate of one head to 3 acres, whereas the native range was stocked at the rate of one head to 9 acres. The rates of stocking were based on previous grazing experiments involving the use of the native range and observations of reserve cattle grazing crested wheatgrass. On both areas there was sufficient vegetation for the cattle to get a fill without difficulty at any time.

The hays used were produced at the Ardmore station. The native hay (77-percent western wheatgrass) graded U. S. No. 3 Extra Green Upland Prairie, and the crested wheatgrass (97-percent pure) graded U. S. No. 1 Extra Green Grass hay. The composition of the feeds used in the 1940-41 wintering experiments is given in table 2. The feeds used in 1941-42 were of approximately the same quality.

TABLE 2.—Composition of feeds used in 1941-42 wintering experiments

Feed	Water	Ash	Protein	Crude fiber	Nitrogen-free extract	Fat
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Native hay (77-percent western wheatgrass).....	6.26	10.14	9.32	27.58	44.08	2.62
Crested wheatgrass hay.....	6.48	5.78	8.60	27.70	47.98	3.46
Beet pulp-molasses pellets.....	8.30	10.38	9.26	17.30	54.50	.26
Cottonseed cake.....	7.05	6.10	40.18	11.46	28.81	6.40

Individual weights of steers were taken on 3 successive days at the beginning and end of each experiment and on 1 day at 28-day intervals throughout each experiment.

RESULTS OF EXPERIMENTS

The average rations, total feed consumption, and gains of the cattle in the two wintering tests and the summer grazing test are given in table 3. The average weights of the steers at the end of each 28-day period are shown graphically in figure 2.

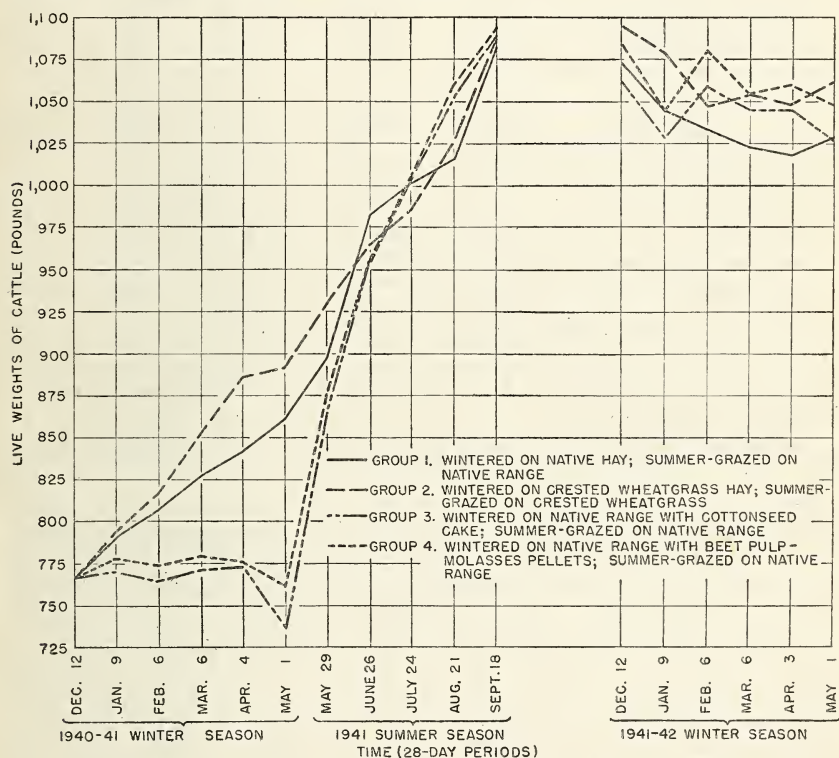


FIGURE 2.—Average live weights of cattle by 28-day periods.

TABLE 3.—*Summary of results of wintering and of summer grazing of cattle from December 12, 1940, to May 1, 1942*¹

[7 steers and 3 spayed heifers per group; each period 140 days in length]

Item	Group 1, wintered on native hay in dry lot and summer- grazed on native range	Group 2, wintered on crested wheatgrass hay in dry lot and sum- mer-grazed on crested wheatgrass	Group 3, wintered on native range with cotton- seed cake and summer- grazed on native range	Group 4, wintered on native range with beet pulp- molasses pellets and summer- grazed on native range
1940-41 winter period (Dec. 12 to May 1):				
Average initial weight per head.....pounds	766	766	766	767
Average final weight per head.....do	861	891	737	761
Average gain (+) or loss (-) per head.....do	+95	+125	-29	-6
Average ration:				
Hay.....do	18.3	19.2	(2)	(2)
Concentrates.....do			.94	.94
Total feed consumed per head:				
Hay.....do	2,561	2,639	(2)	(2)
Concentrates.....do			132	132
Salt.....do	8.9	9.3	8.0	8.8
Value of feed, including range and salt per head ² dollars	12.94	13.58	7.19	7.20
1941 summer grazing period on range (May 1 to Sept. 18):				
Average final weight per head.....pounds	1,081	1,087	1,088	1,092
Average gain per head.....do	220	196	351	331
Salt consumed per head.....do	9	9	9	9
Value of range and salt ³ dollars	4.34	4.34	4.34	4.34
1940-41 winter and summer period (Dec. 12 to Sept. 18):				
Average gain per head.....pounds	315	321	322	325
Total cost of gain per head.....dollars	17.28	17.92	11.53	11.54
Cost of 100 pounds of gain.....do	5.48	5.58	3.58	3.55
1941-42 winter period (Dec. 12 to May 1):				
Average initial weight per head.....pounds	1,073	1,095	1,063	1,084
Average final weight per head.....do	1,029	1,059	1,028	1,049
Average loss per head.....do	44	36	35	35
Average ration:				
Hay.....do	14.64	14.98	² 1.07	² 1.07
Concentrates.....do			1.00	.93
Feed consumed per head:				
Hay.....do	2,050	2,097	² 150	² 150
Concentrates.....do			140	130
Salt.....do	19.7	22	4.7	5.0
Value of feed, including range and salt per head ³ dollars	10.55	10.81	8.59	8.01

¹ From September 18 to December 12, 1941, the groups were not on experiment and were grazed on reserved native range.² On range for the 140-day period.³ At the following prices: Range, \$0.03 per head daily; native-grass and crested wheatgrass hays, \$10.00 per ton; salt, \$30.00 per ton; cottonseed cake, \$43.50 per ton in 1940-41 and \$51.00 in 1941-42; beet pulp-molasses pellets, \$43.50 per ton in 1940-41 and \$45.92 in 1941-42.

During the first winter the cattle fed in dry lot (groups 1 and 2) made unusually good gains in proportion to the feed consumed—an average of 110 pounds per head on an average ration of about 18.7 pounds of hay. Each of these groups was fed at the rate of 20 pounds of hay per head daily. Some was refused by each group during the first two periods, but more by the one fed native hay (group 1). Accordingly, the cattle fed crested wheatgrass (group 2) consumed about 1 pound more per head daily than did those fed native hay but produced 30 pounds more gain during the 140-day winter period at an additional cost of only \$0.64. About 27 pounds of native hay was required per pound of gain, as compared with only 21.5 pounds of crested wheatgrass hay. However, the higher feeding value of the crested wheatgrass was of little consequence in this experiment because at the end of the subsequent summer grazing season of 140 days, there was a difference of only 6 pounds per head in favor of the group

receiving this hay. If the cattle had been marketed at the end of the winter period, the additional gain obtained from feeding crested wheatgrass would have more than offset the increased feed cost. For the winter and summer period, the average feed cost per 100 pounds of gain for the cattle fed crested wheatgrass was \$0.10 more than for those fed native hay. Differences in cost of gains and in total summer and winter gains between the two hay-fed groups were not statistically significant, according to the method of Snedecor (?).

The cattle wintered on crested wheatgrass hay in dry lot and grazed on crested wheatgrass pasture in the summer (group 2) made 24 pounds less summer gain than those wintered on native hay and grazed on native range in the summer (group 1). This difference was not statistically significant. However, the cattle on crested wheatgrass gained 65 pounds per acre grazed, whereas those on native range gained only 24 pounds. This difference was highly significant.

The groups wintered on the range with supplements lost weight during the 140-day period in the first winter. Both groups were fed a ration of 1 pound per head of the supplements, but they refused them for the first 10 days; hence the average ration during the entire winter period was only 0.94 pound. As the costs of the supplements used the first year were the same, the wintering costs of these two groups were essentially the same. During the 140-day summer grazing season on native range, the cattle in group 3, which had slightly lower winter gains, made correspondingly greater summer gains, and for the total winter and summer periods there was only 3 pounds' difference in the gains of the two groups. These results, although in no way conclusive, indicate that the two supplements were about equal in value for use with native range for wintering cattle. The results also indicate that yearling feeder cattle, under the conditions of this experiment, can be wintered satisfactorily and more economically on native range that had been reserved for winter grazing, with small quantities of concentrates as supplements, than in dry lot on native and crested wheatgrass hays. The average cost of feed, including the range, was approximately \$6 more per head for the cattle wintered in dry lot than for those wintered on the range.

During the second wintering experiment the groups in dry lot were fed rations of 15 pounds of hay per head, but the amount consumed was somewhat less than this, as shown in table 3. The average loss in weight of these cattle was 40 pounds for the 140-day winter season, group 1 cattle losing 8 pounds more per head than group 2. Differences in weight losses, feed costs, and hay consumption of the two groups were of no significance. As the range was covered with snow late in December and during the early part of January, it was necessary to feed 10 pounds of hay per head daily for 15 days to the cattle wintered on the range with concentrate supplements. During this experiment the cattle in group 3 consumed their ration of cottonseed cake throughout the 140 days, but the cattle in group 4 refused their concentrate, in pellet form, during the last 10 days. The average losses in weight for the cattle in these two groups were identical, but the feed cost per head for group 3 exceeded that for group 4 by \$0.58. This additional cost is attributable to the fact that cottonseed cake was priced at \$5.08 per ton more than beet pulp-molasses pellets. The wintering cost for the cattle

TABLE 4.—Average rations, total feed consumption, and gains or losses of the cattle for the two winter seasons of 140 days each

Item	Group 1, wintered on native hay	Group 2, wintered on crested wheat grass hay	Group 3, wintered on native range with cotton- seed cake	Group 4, wintered on native range with beet pulp-molasses pellets
Average initial weight per head.....pounds.....	920	931	915	976
Average final weight per head.....do.....	945	975	883	905
Average gain (+) or loss (-) per head.....do.....	+25	+44	-32	-21
Average ration:				
Hay.....do.....	16.47	17.09	1.54	1.54
Concentrates.....do.....			.97	.935
Feed consumed per head:				
Hay.....do.....	2,306	2,393	175	175
Concentrates.....do.....			132	131
Salt.....do.....	14.3	15.6	6.4	6.9
Value of feed and salt, including range, per head ² dollars.....	11.75	12.20	7.89	7.61

¹ On range for the entire winter season.² See footnote 3, table 3, for feed prices.

in dry lot averaged \$2.38 more per head than for those wintered on the range with supplemental feeds.

Figure 2 shows that during the progress of the experiments the groups wintered on hay in dry lot paralleled each other rather closely and that those wintered on the range paralleled each other still more closely. These same relationships continued throughout the subsequent summer season. The groups on range both winter and summer made the more consistent gains throughout the summer. During the progress of the second winter there was more variation in gains

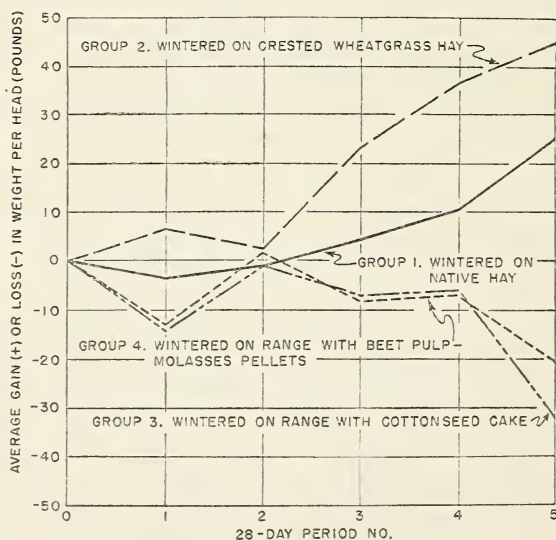


FIGURE 3.—Average winter gains of cattle for the two winter seasons.

and losses in weight than during the previous winter, but by the end of the season there was practically no difference in winter losses between any of the groups.

The rations, total feed consumption, and feed costs for the two wintering experiments are averaged in table 4. The average gains or losses per head for the two wintering experiments, 1940-41 and 1941-42, are shown graphically in figure 3.

For the 2-year period the groups fed hay made an average gain of about 35 pounds per head, as compared with an average loss of about 27 pounds for the cattle wintered on the range with supplemental feed. This difference is significant, but the difference in gains between the two groups of hay-fed cattle wintered in dry lot (groups 1 and 2) was not significant. Likewise the difference in losses between the two groups of cattle handled on the range (groups 3 and 4) was not significant.

The cattle fed in dry lot consumed an average ration of nearly 17 pounds of hay, and the cattle on the range consumed a little more than one-half pound of hay and a little less than 1 pound of concentrates in addition to the winter range. The feed costs averaged about \$12 per head for the groups in dry lot and \$7.75 for the groups on range. Even though the former groups were in better condition at the end of the winter period, the additional cost for their feed would usually not be justified, especially if the cattle are not to be sold until the end of the subsequent grazing season.

SUMMARY

Experiments were carried on at the Ardmore Field Station, Ardmore, S. Dak., to determine the relative values of native grass (mostly western wheatgrass) and crested wheatgrass as hays for wintering beef cattle and as summer grazing crops for cattle. In addition, facilities were available to compare cottonseed cake and beet pulp-molasses pellets as supplements to the native range for wintering beef cattle. The experiments were conducted for two winter periods of 140 days each in 1940 and 1941 and for one summer season of 140 days in 1941.

Forty head of well-bred Hereford yearlings consisting of 28 steers and 12 spayed heifers were used. These cattle were allotted as equally as possible, in regard to sex, quality, and weight, into four groups. Two of the groups were wintered in dry lot, the one on native hay and the other on crested wheatgrass hay. The other two were wintered on essentially unlimited native range, the one receiving cottonseed cake and bonemeal, and the other receiving pellets consisting of beet pulp, molasses, and bonemeal. When the range was snow-covered, roughage was fed. The native hay was predominately western wheatgrass (*Agropyron smithii* Rydb.), and the crested wheatgrass hay (*A. cristatum* Gaertn.) was approximately 97 percent pure. The period immediately preceding the experiments, as well as the period during which the experiments were carried on, was favorable for vegetative growth. During the summer, the cattle grazing on native vegetation had 9 acres per head, whereas those on crested wheatgrass had but 3.

Crested wheatgrass hay was more palatable than native hay as shown by the fact that a smaller quantity of it was refused by the cattle wintered in dry lot. Rations of 20 pounds of either native hay or crested wheatgrass hay of good quality were sufficient to produce about 100 pounds of gain on yearling feeder cattle during a winter season of

140 days. However, rations of approximately 15 pounds of these hays were not sufficient to maintain the weight of 2-year-olds during the winter season. On the average for the 2 years, about 17 pounds of these hays produced a winter gain of nearly 34.5 pounds per head for the yearlings and 2-year-olds. Although the gains or losses in weight between the hay groups were not significant in either year, the crested wheatgrass hay was somewhat more efficient in ability to produce cattle gain. The results of the 2 years' work indicate that native and crested wheatgrass hays are approximately equal in feeding values for wintering yearling and 2-year-old feeder cattle, and that the relative costs of these hays could well be the governing factor in choosing between them.

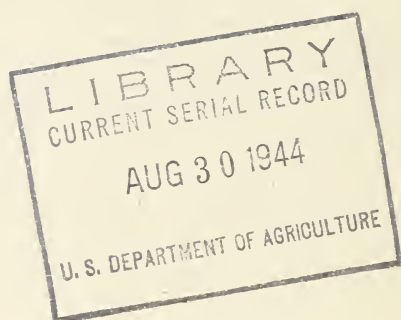
Crested wheatgrass and native grasses (western wheatgrass predominating) produce similar gains on 2-year-old cattle when grazed at rates of stocking that afforded cattle the opportunity to get their fill without difficulty. When grazed at the rate of 3 acres per head, crested wheatgrass produced 65 pounds of beef per acre as compared with 24 pounds made by steers grazing the native range at the rate of 9 acres per head.

A high protein and low carbohydrate concentrate (cottonseed cake) and a low protein and high carbohydrate concentrate (beet pulp-molasses pellets) appeared to be of about equal value when fed as supplements to the native range for wintering yearlings and 2-year-old cattle.

The average results of two winter seasons indicate that a ration of about 17 pounds of hay fed to cattle in dry lot produces better results than the native range supplemented with a pound of concentrates and a small quantity of roughage when the range is snow-covered. However, the average cost of wintering in dry lot on hay was \$4.23 more per head than on the range. Furthermore, there was no significant difference in total winter and summer gains between the two systems. Under the conditions of these experiments, therefore, there is a considerable advantage in favor of using the range with a supplement for wintering, when cattle are to be marketed at the end of the summer grazing season.

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